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TO: K. Z. Morgan - W. S. Snyder

FROM: D. M. Davis

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HEALTH PHYSICS DIVISION

APPLIED HEALTH PHYSICS QUARTERLY REPORT - JANUARY, FEBRUARY, AND MARCH OF 1963

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TABLE OF CONTENTS

1.0 MONITORING SUMMARY

1.1 Unusual Occurrences

Thirteen unusual occurrences were recorded during the first quarter. The quarterly average for 1962 was 15.

1.2 Personnel Exposures

Eleven radiation exposures were recorded during the first quarter of 1963 which equalled or exceeded 1/3 of a maximum permissible quarterly dose. In each case a total body dose was involved. The highest exposure received was 53 per cent of the maximum permissible quarterly dose and this was the only evidence of an exposure in excess of 50 per cent of the maximum permissible value.

1.3 Atmospheric Monitoring

Air-borne radioparticulate matter collected by the LAM network (Laboratory area) averaged 5.2×10^{-12} μc/cc during the quarter; the average value determined from the data generated by the PAM network (Oak Ridge controlled area) was 4.9×10^{-12} μc/cc; the value for the RAM network (remote stations) was 5.6×10^{-12} μc/cc. The above values (together with other data shown in this report) indicate that Laboratory operations did not contribute significantly to air contamination levels recorded in the East Tennessee area during the first quarter of 1963.

1.4 Water Monitoring

Clinch River water taken from the ORGDP water intake (CRM 14.5) during the quarter averaged 12 per cent of the $(MPC)_w$ considered permissible for persons residing in the neighborhood of an atomic energy installation. The average recorded during 1962 was 11.2 per cent of the $(MPC)_w$. Approximately one-half of the $(MPC)_w$ value was contributed by fall-out resulting from world-wide weapons testing and other factors not associated with Laboratory operations.

1.5 Background Measurements of Ionizing Radiation

The background radiation at ORNL averaged 0.11 mR/hr during the first quarter of 1963. The background level measured at individual stations ranged from a minimum of 0.02 mR/hr to a maximum of 2.5 mR/hr. The off-site average was 0.025 mR/hr. The quarterly average recorded during 1962 at ORNL was 0.11 mR/hr; the off-site average during 1962 was 0.030 mR/hr.

2.0 UNUSUAL OCCURRENCES

The Applied Health Physics Annual Report for 1959 (ORNL-3073) established certain ground rules for classifying radiation accidents, or near accidents, and the term "unusual occurrence" was adopted to describe these events. Following the publication of ORNL-3073, the definition of the unusual occurrence has been gradually expanded to include one or more of the following circumstances:

1. A violation of a health physics regulatory policy.
2. An event which might have resulted in significant personnel exposure or environmental contamination under less fortunate circumstances.
3. An event which might have had an adverse effect on public relations under less fortunate circumstances.
4. A radiation or contamination incident of a magnitude sufficient to result in a significant interruption of the normal operational routine requiring an evaluation of personnel exposures and/or special clean-up measures.
5. An event which results in a radiation dose to personnel that equals or exceeds (a) 0.3 rem to the total body, (b) 1.0 rem to the skin of the total body, (c) 2.5 rem to the extremities of the body, and/or (d) an internal exposure of 25 per cent or more of the excretion index.[1]
6. Laboratory operations are such as to result in the contamination of the environment (a) in excess of levels recommended by the Federal Radiation Council (FRC) or (b) where the cost of lost time, decontamination operations, and/or loss of equipment equals or exceeds the sum of $500.

During the years 1961-1962, some attempt was made to classify the unusual occurrence into <u>minor</u> and <u>major</u> phases. However, this two-part classification proved to be too broad in that the major event, by definition (ORNL-3284, p. 10), covered a wide range of circumstances which included simple technical oversights that were not distinguished from events which took on more serious proportions. Consequently, during the summer of 1962, a joint study was undertaken by Applied Health Physics and Radiation Safety and Control personnel which resulted in the establishment of guidelines for classifying unusual occurrences according to a severity index system.[2]

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[1] The excretion index (EI) is that quantity of an internally deposited radioisotope which is estimated to be eliminated in the urine during a 24-hour period if the person has a maximum permissible body burden of the radioisotope as defined in NCRP Handbook 69 (published by NBS) for the occupational worker.

[2] Radiation Safety and Control Quarterly Report—July, August, and September, 1962, ORNL-CF-62-11-19, November 5, 1962.

Urgent
Avail?
Rec'd?

2.1 Unusual Occurrence Severity Index System

A. Minor Occurrence - An occurrence which does not qualify as a "radiation event" (described below) will be classified as a "minor occurrence" if the occurrence involves one or more of the following:

1. A violation of a health physics regulatory policy.
2. An occurrence which might have had an adverse effect on public relations or would have resulted in a radiation accident under less fortunate circumstances.
3. An occurrence involving an unplanned personnel exposure where (a) the external exposure in any one work week is in the range (i) 0.1 to 0.3 rem for exposure to the total body, head and trunk, lens of the eye, gonads, or blood forming organs, (ii) 0.6 to 1.0 rem for exposure to the skin of the body, (iii) 1.5 to 2.5 rem for exposures to the extremities, and/or (b) an individual is exposed to radiocontaminants at levels which require decontamination under medical supervision of a nature that (i) the external exposure resulting from such contamination does not equal or exceed the above prescribed upper limits, and (ii) the internal exposure is such that analysis of body fluids indicates an elimination rate that is less than 25 per cent of the excretion index. (The limits established above are based on provisions set forth in Procedure No. 20, Reg. No. 2, p. 3 of the Health Physics Manual.)
4. An occurrence involving the uncontrolled release of radioactivity which results in a significant interruption of the normal operating routine under conditions where the maximum permissible concentration (MPC) values are not exceeded when averaged over a 24-hour period and/or the combined costs of evaluation and recovery are less than $500.

Not in practice.

B. Radiation Event - The radiation event is defined as an occurrence involving one or more of the following:

1. An occurrence which results in (a) a radiation dose to personnel that equals or exceeds (i) 0.3 rem to the total body, (ii) 1.0 rem to the skin of the body, (iii) 2.5 rem to the extremities, and/or (d) an internal exposure such that analysis of body fluids indicates an elimination rate equal to or exceeding 25 per cent of the excretion index.
2. An occurrence involving an unplanned release of radioactive materials to the environment such that the resulting levels, averaged over a period of 24 hours, exceeds the appropriate MPC.
3. An occurrence resulting in recovery and/or evaluation costs equal to or exceeding the sum of $500.

The radiation event has been assigned a severity index class number according to personnel exposure ranges, contamination levels, and/or cost analyses. The classification numbers assigned to each range are shown in Table 2.1 on the following page.

2.2 Reporting Procedure

Unusual occurrences are described in memoranda prepared jointly by Health Physics Division staff members and Division personnel assigned to the divisions involved in the occurrence. In general, the minor occurrences receive a limited distribution depending upon the type of occurrence and the informative quality of the information being disseminated. The radiation events are formally documented and given a general distribution to all supervisory personnel. Class III and Class IV events are reported formally to AEC-ORO headquarters within a few hours after it has been established that a radiation event of this classification has occurred. (See AEC Manual Chapter 0502 for a detailed breakdown on reporting requirements.)

The Applied Health Physics quarterly reports carry an account of the minor occurrences in tabular form by (1) date, (2) facilities involved, (3) divisions involved, and (4) subject matter (see Table 5.1). The radiation events are treated briefly in digest form in the quarterly reports. The Applied Health Physics Annual Report gives a statistical treatment as might be appropriate concerning the Laboratory experience with the unusual occurrence concept.

2.3 Unusual Occurrences - 1st Quarter, 1963

The Laboratory experienced 13 unusual occurrences during the first quarter of 1963. All 13 events were classified as minor occurrences as indicated in Table 5.1.

Table 2.1 Radiation Event Severity Index

Class	External Exposure (rem)			Internal Exposure	Unplanned radiocontaminant Release Averaged over a Twenty-four Hour Period	Cost Ranges
	Total Body	Skin	Extremities			
I	0.3 to 1.0	1 to 3	2.5 to 8	(Body Fluids) 0.25 x EI to 1.0 x EI	Exceeds the MPC Value	$500 to $1,000
II	1 to 3	3 to 10	8 to 25	(Body Fluids) 1.0 x EI or more	Exceeds 1000 x MPC	$1,000 to $5,000
III	3* to 25	10 to 150	25 to 375	(Body Burden) Exceeds the RPG	------------------	$5,000 to $100,000
IV	25* or more	150* or more	375* or more	---------------	Exceeds 5000 x MPC	$100,000 or more

Terms: (a) EI is the excretion index; (b) RPG is the radiation protection guide limits established by the Federal Radiation Council; (c) MPC is the maximum permissible concentration value recommended in NCRP Handbook 69 (published by NBS).

*These levels are taken from the reporting instructions given in AEC 0502-057, "Reporting and Investigating Accidents and Radiation Exposures".

3.0 PERSONNEL MONITORING

3.1 External Dose Measurements

The highest total body exposure recorded during the first quarter (see Table 5.2) was 1.6 rem and the second highest exposure was 1.4 rem. (Maximum permissible quarterly total body exposure is 3 rem.) The highest total body skin dose recorded during the quarter was 1.8 rem and the second highest was 1.7 rem. The maximum permissible quarterly total body skin dose is 10 rem.

3.2 Internal Dose Measurements

Bio-Assays - Three employees continued to have an estimated bone burden of Pu-239 which approximates 1/3 of the maximum permissible body burden.[3] Continued surveillance of the employee whose case was described in the last quarterly report of this Section indicated that the major portion of the exposure was due to Np-237.

Whole Body Counter[4] - A total of 137 human counts on 104 persons was carried out by the staff of the whole body counting facility during the first quarter. Among the number counted, 52 individuals indicated measurable amounts of radioactivity above the average unexposed human background of about 10 nanocuries Cs-137; five individuals were shown to have accumulated two or more isotopes not normally found in the average person.

Radioactivity Found in Routine Whole Body Monitoring Program—January, February, March, 1963

Isotope	No. of Persons	Highest Quantity Measured (μc)	Maximum Permissible Burden (μc)
Cs-137	39	0.12	30 (whole body)
I-131	11	0.15	0.7 (thyroid)
Zr-95	7	0.014	20 (whole body)
Sb-125	1	0.006	40 (whole body)
Sr-90	1	0.03	0.8 (lung)

[3] Action is taken to curtail an employee's exposure to internal emitters when measurements approach 30 per cent of a body burden.

[4] Data supplied by Applied Health Physics Technology Section.

4.0 ENVIRONMENTAL MONITORING

4.1 Atmospheric Monitoring

The average weekly concentrations of radioactive materials in air sampled by the three ORNL air monitoring networks[5] are shown in Table 5.3. The quarterly average for the LAM network was 5.2×10^{-12} μc/cc with weekly values at individual monitoring stations ranging from a minimum of 1.6×10^{-12} μc/cc to a maximum of 8.3×10^{-12} μc/cc. Averages for the PAM and RAM networks were 4.9×10^{-12} μc/cc and 5.6×10^{-12} μc/cc, respectively, with weekly values ranging from a minimum of 2.7×10^{-12} μc/cc to a maximum of 7.9×10^{-12} μc/cc. The radioactive concentration in air began to rise during the first part of the quarter and continued to persist at higher levels through the remainder with a slight drop at RAM network stations (Fig. 6.1). This increase in concentration was fairly uniform at all network stations leading to the presumption that the effect of world-wide weapons testing persists.

4.2 Fall-Out Measurements

Fall-out measurements by the gummed-paper technique[6] indicated that fall-out in terms of total numbers of particles per square foot was highest during the month of January. The levels reached in January, however, were not as high as some individual weekly levels measured during the last quarter of 1962. The weekly average fall-out for each network is presented in Table 5.4. The number of radioparticulates collected on gummed-paper, fall-out trays depends upon particle size distribution and meteorological conditions existing at the time of collection. The radioparticulate matter collected on air monitoring filters is related to particle size distribution and will be influenced by the linear velocity of the air stream incident to the surface of the filter. In addition, the total activity collected on the filters is related to the number of radioparticulates collected and the specific activity of the particles. Thus, the number of radioparticulates collected on gummed paper trays does not necessarily correlate with the number of radioparticulates collected on air monitoring filters. Consequently, a lack of correlation between the data generated by the two networks may be due to preferential sampling. The data derived from the two networks for the month of January (Figures 6.1 and 6.2) typify a situation where the two methods provide somewhat different estimates for aerosol activity.

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[5] LAM - Local Air Monitor (located at or near the ORNL site); PAM - Perimeter Air Monitor (located on the outer boundary of the AEC controlled area); RAM - Remote Air Monitor (located from 12 to 75 miles from ORNL).

[6] The gummed-paper collector presents a collection surface of 1 square foot. Radioparticulates per square foot are determined by autoradiography.

4.3 Water Analysis

Rain Water - The quarterly average concentration of radioactive materials deposited in rain water collected over the LAM, PAM, and RAM networks was 1.3×10^{-6} μc/ml, 1.4×10^{-6} μc/ml, and 1.8×10^{-6} μc/ml, respectively. The LAM and PAM average values were about twice the values recorded by these networks during the last quarter of 1962; the RAM network average during the first quarter of 1963 was greater than the last quarter RAM network average by a factor of about 1.5. The quarterly average concentration recorded at each collection station is given in Table 5.5. The concentration of radioactive materials in rain water for the first quarter of 1963 is consistent with the average values measured during 1962 (Fig. 6.3) and supports the presumption of continued fall-out from world-wide weapons testing.

Clinch River Water - Approximately 290 curies of various radioisotopes were discharged via White Oak Creek into the Clinch River during the first quarter of 1963. The isotopic distribution of radionuclides in the White Oak Lake effluent is given for the months of January, February, and March in Table 5.6. About 92 per cent of the curie content of the White Oak Lake effluent was due to Ru-106, the bulk of which enters White Oak Lake from the seepage pit area of the intermediate-level waste disposal system. Ru-106 contributes about 43 per cent to the calculated maximum permissible concentration, $(MPC)_w$, at the juncture of White Oak Creek and the Clinch River (CRM 20.8). Assuming a uniform mixing of White Oak Lake effluent with the Clinch River at CRM 20.8, the calculated monthly average gross beta concentration in the Clinch River resulting from ORNL liquid waste discharges was as follows:

Month	Concentration[7]	% $(MPC)_w$[8]
January	0.34×10^{-6} μc/ml	8.1
February	0.25×10^{-6} μc/ml	4.6
March	0.11×10^{-6} μc/ml	2.5

The above average concentration values (taken from Table 5.7) represent about five per cent of the $(MPC)_w$. (The average concentration value for the fourth quarter of 1962 was about seven per cent of the $(MPC)_w$.)

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[7] Calculated values based upon the dilution afforded by the river; these values do not include radioactive materials (e.g., fall-out) that enter the river upstream from CRM 20.8.

[8] Weighted average $(MPC)_w$ for populations residing in the neighborhood of a controlled area calculated for the isotopic mixture using $(MPC)_w$ values for specific radionuclides recommended in NBS Handbook 69.

The measured average concentration of radioactive materials in Clinch River water sampled at the ORGDP water filtration plant intake (CRM 14.5) was as follows:

Month	Concentration	% $(MPC)_w$
January	0.42×10^{-6} μc/ml	17
February	0.36×10^{-6} μc/ml	15
March	0.21×10^{-6} μc/ml	4.7

The above values (taken from Table 5.8) represent about 12 per cent of the $(MPC)_w$ value for the specific radionuclides present. A comparison of the per cent $(MPC)_w$ for January, February, and March with the values determined for the years 1956 through 1962 is presented in Fig. 6.4. The difference between the calculated values (computed for CRM 20.8) and the measured values (determined at CRM 14.5) may be due, in part, to the presence of fall-out materials in Clinch River water.

4.4 Background Measurements of Ionizing Radiation

The average background level recorded during the first quarter at the 53 stations located on the Laboratory site was 0.11 mR/hr. The background level measured at individual stations ranged from a minimum of 0.02 mR/hr to a maximum of 2.5 mR/hr. The average level recorded at five stations located off-site around the perimeter of the Oak Ridge controlled area was 0.025 mR/hr. From Table 5.9 it is observed that background levels on the ORNL site were about ten times those recorded in 1943 prior to the start-up of the graphite reactor; the first quarter background averages in the Oak Ridge controlled area were about two times the 1943 level. The average background for the first quarter of 1963 (Fig. 6.5) was essentially the same as the average for 1962.

Tower Shielding Facility (TSF) operations during the first quarter resulted in a measured average dose rate of 0.015 mR/hr at the point (Melton Hill Dam site) nearest the TSF where members of the general public may have unrestricted access.[9] The above value (0.015 mR/hr) is well below the maximum permissible non-occupational exposure permitted for persons residing in the neighborhood of an atomic energy installation.[10]

4.5 Milk Samples

Samples of raw milk were collected routinely at six milk sampling stations located out to distances of about 25 miles from ORNL and

[9] The accumulated total radiation dose at 3400 feet from the TSF-II as calculated from monitor data is 107 mrem. Calculations of dose from kw-hrs (generated) gave 157 mrem. (Data taken from TSF operating reports—L. B. Holland to file.)

[10] Federal Radiation Council, Staff Report No. 1, "Background Material for the Development of Radiation Protection Standards", May 13, 1960, p. 38.

analyzed for I-131 and Sr-90. The average concentration of I-131 in raw milk during the quarter was 55 pc/liter which is about 50 per cent lower than the average levels measured during 1962. Concentration values for individual milk samples ranged from the minimum detectable concentration (10 pc/liter) to a maximum of 170 pc/liter. Lower concentrations of I-131 in raw milk were expected following the curtailment in weapons testing late in 1962. The average value for the quarter represents about 50% of the upper limit of Range II for the daily intake of I-131 as established by the Federal Radiation Council.

Sr-90 concentrations in raw milk ranged from 15 pc/liter to 76 pc per liter in individual samples analyzed during the quarter; the average concentration of Sr-90 in raw milk sampled during the quarter was determined to be 27 pc/liter, which is about 15% of the upper limit of FRC Range II for Sr-90.

5.0 TABLES

Table 5.1 Unusual Occurrences Tabulated for 1st Quarter, 1963

No.	Date	Facility(s) Involved	Division(s) Involved	Subject of Occurrence
1.	1-5-63	Bldg. 3019 (Penthouse)	Chem. Tech.	Accidental Release of Air-Borne Radioactive Materials.
2.	1-15-63	Bldg. 9207 Y-12	Biology	Violation of Rule Governing Pipetting of Radioactive Materials by Mouth.
3.	1-16-63	Bldg. 3019 (HRLAF)	Anal. Chem.	Personnel Contamination, Alpha Emitter.
4.	1-22-63	Bldg. 3019 (HRLAF)	Anal. Chem.	Personnel and Facility Contamination, Alpha Emitter.
5.	1-28-63	Bldg. 3550 (Rm. 21)	Anal. Chem.	Accidental Release of Small Quantity of Cm^{242}.
6.	1-30-63	Bldg. 4500	Physics	Radioactive Contamination Resulting from Resizing a Tritiated Metal Foil.
7.	2-13-63	Bldg. 3019 (Penthouse)	Chem. Tech.	Radiocontaminant Release during a Nitrogen-Fluorine Purging Operation.
8.	2-23-63	Bldg. 3010 (B.S. Reactor)	Neutron Phys.	A Potential Contamination Event Involving a Group on Tour.
9.	3-10-63	Bldg. 3042 (ORR)	Operations	Accidental Release of Xe^{133} from Loop # 1 GCR Experiment.
10.	Unknown	Bldg. 7702 (TSF)	Neutron Phys.	Potential Hazard from Broken Reactor Hoist Cable.
11.	3-13-63	Bldg. 3038 (Isotope Shipping)	Isotopes	P^{32} Contamination Resulting from Loading of Isotopes for Shipment.
12.	3-27-63	Burial Ground # 5	E and M	Spread of Cs^{137} While Unloading Stainless Steel Dumpster.
13.	3-29-63	Bldg. 5500	Physics	Tritium Contamination of the 5 MV Van de Graaff Accelerator.

Table 5.2 Personnel Meters Exposure Resume—1st Quarter, 1963

Employee	Laboratory Division	First Quarter Dose		Cumulative Dose for 1963	
		Skin of Total Body (rem)	Total Body (rem)	Skin of Total Body (rem)	Total Body (rem)
A	Isotopes	1.6	1.6	1.6	1.6
B	Isotopes	1.5	1.4	1.5	1.4
C	Isotopes	1.3	1.3	1.3	1.3
D	Isotopes	1.7	1.2	1.7	1.2
E	Isotopes	1.5	1.2	1.5	1.2
F	Isotopes	1.5	1.2	1.5	1.2
G	I & C	1.1	1.0	1.1	1.0
H	Operations	1.2	1.0	1.2	1.0
I	Chem. Tech.	1.1	1.0	1.1	1.0
J	Isotopes	1.4	1.0	1.4	1.0
K	Isotopes	1.1	1.0	1.1	1.0

Note: Table 5.1 includes a breakdown of exposures for employees whose recorded dose equals or exceeds approximately 1/3 of the Laboratory operating limits.

Table 5.3 Concentration of Radioactive Materials in Air Averaged Weekly from Filter Paper Data—1st Quarter, 1963

Week No.	LAM Network[a]	PAM Network[b]	RAM Network[c]
1	3.6×10^{-12} μc/cc	3.4×10^{-12} μc/cc	4.6×10^{-12} μc/cc
2	3.5	3.1	4.1
3	3.6	3.5	4.5
4	6.1	5.7	6.5
5	5.0	4.8	5.6
6	6.7	5.9	6.6
7	4.9	4.4	5.0
8	5.9	5.4	6.5
9	6.2	6.0	6.7
10	5.0	4.5	5.0
11	6.3	6.2	6.3
12	4.7	5.3	5.5
13	6.2	6.1	6.2
Average for Quarter	5.2×10^{-12} μc/cc	4.9×10^{-12} μc/cc	5.6×10^{-12} μc/cc
Average for Year to Date	5.2×10^{-12} μc/cc	4.9×10^{-12} μc/cc	5.6×10^{-12} μc/cc
Average for Last Year 1962	3.7×10^{-12} μc/cc	3.6×10^{-12} μc/cc	4.3×10^{-12} μc/cc

[a]LAM - Local Air Monitor located at or near the ORNL site.

[b]PAM - Perimeter Air Monitor located on the outer boundary of the AEC-controlled area.

[c]RAM - Remote Air Monitor located from 12 to 75 miles from ORNL.

Table 5.4 Radioparticulate Fall-Out Measurements Averaged Weekly From Gummed Paper Data—1st Quarter, 1963

no meaning for [illegible] except [illegible]

Week No.	LAM Network	PAM Network	RAM Network
1	56 particles/ft^2	51 particles/ft^2	35 particles/ft^2
2	120	110	69
3	170	150	70
4	100	120	55
5	100	110	65
6	32	32	21
7	13	9	7
8	34	42	45
9	42	60	43
10	45	50	46
11	61	50	37
12	10	9	7
13	9	10	9
Average for Quarter	61 particles/ft^2/wk	62 particles/ft^2/wk	39 particles/ft^2/wk
Average for Year to Date	61 particles/ft^2/wk	62 particles/ft^2/wk	39 particles/ft^2/wk
Average Last Year (1962)	48 particles/ft^2/wk	48 particles/ft^2/wk	35 particles/ft^2/wk

Table 5.5 Concentration of Radioactive Materials in Rain Water Averaged for the Quarter by Stations—1st Quarter, 1963

Station Number	Location	Concentration
	LAM Network	
HP-7	West of 7001	1.3×10^{-6} μc/ml
	PAM Network	
HP-31	Kerr Hollow Gate	1.7×10^{-6} μc/ml
HP-32	Midway Gate	1.4
HP-33	Gallaher Gate	1.2
HP-34	White Oak Dam	1.3
HP-35	Blair Gate	1.3
HP-36	Turnpike Gate	1.5
HP-37	Hickory Creek Bend	1.6
Network Average		1.4×10^{-6} μc/ml
	RAM Network	
HP-51	Norris Dam	2.0×10^{-6} μc/ml
HP-52	Loudoun Dam	1.4
HP-53	Douglas Dam	1.5
HP-54	Cherokee Dam	2.5
HP-55	Watts Bar Dam	1.8
HP-56	Great Falls Dam	1.9
HP-57	Dale Hollow Dam	1.9
Network Average		1.8×10^{-6} μc/ml

Table 56 Radioisotopic Distribution in White Oak Lake Effluent—1st Quarter, 1963

Isotope	% of Total Beta Radioactivity		
	January	February	March
Ru^{106}	91	93	92
Zr^{95}	0.24	0.04	0.08
Nb^{95}	0.04	0.06	0.21
TRE (less Ce^{144})*	1.0	2.5	1.2
Cs^{137}	0.24	0.23	0.50
I^{131}	0.12	0.06	0.17
Ce^{144}	0.08	0.06	1.2
Ba^{140}	0.04	0.04	0.21
Co^{60}	4.6	3.0	2.6
Sr^{89}	0.28	0.17	0.25
Sr^{90}	1.5	1.0	1.5
Ci total			= 290

* TRE-Total rare earths

Table 5.7 Average Concentration of Major Radioactive Constituents in the Clinch River at Mile 20.8 Resulting from ORNL Waste Releases via White Oak Lake[a]—1st Quarter, 1963

Month	Radionuclides of Primary Concern (10^{-8} µc/ml)					Gross Beta	$(MPC)_w$[b]	%
	Sr^{90}	Ce^{144}	Cs^{137}	$Ru^{103-106}$	Co^{60}	(10^{-6} µc/ml)	(10^{-6} µc/ml	$(MPC)_w$[b]
January	0.15	0.07	0.03	10	0.48	0.34	4.2	8.1
February	0.20	0.01	0.05	24	0.62	0.25	5.4	4.6
March	0.07	0.05	0.03	4.4	13	0.11	4.4	2.5

[a]Calculated values based upon the dilution afforded by the river; these values do not include radioactive materials (e.g., fall-out) that enter the river upstream from CRM 20.8.

[b]Weighted average $(MPC)_w$ for populations residing in the neighborhood of a controlled area calculated for the mixture using $(MPC)_w$ values for specific radionuclides recommended in NBS Handbook 69.

Table 5.8 Average Concentration[a] of Radioactive Materials in Clinch River Water at ORGDP Filtration Plant Intake—1st Quarter, 1963

Month	Radionuclides of Primary Concern (10^{-8} μc/ml)		Gross Beta	$(MPC)_w$[b]	%
	Sr^{89-90}	$Ru^{103-106}$	(10^{-6} μc/ml)	(10^{-6} μc/ml)	$(MPC)_w$[b]
January	1.30	42	0.42	2.5	17
February	1.20	30	0.36	2.4	15
March	0.23	19	0.21	4.3	4.7

[a]Observed values based on analyses of weekly composited samples.

[b]Weighted average $(MPC)_w$ for populations in the vicinity of a controlled area calculated for the mixture using $(MPC)_w$ values for specific radionuclides recommended in NBS Handbook 69.

Table 5.9 Background Measurements of Ionizing Radiation—1st Quarter, 1963

Area	Monthly Average for All Stations (mr/hr)			Quarterly Average for All Stations (mr/hr)	Year to Date Average All Stations (mr/hr)
	January	February	March		
Laboratory Site (53 stations)	0.120	0.120	0.098	0.110	0.110
Off-Site (Oak Ridge Controlled Area) (5 stations)	0.028	0.019	0.028	0.025	0.025

Note: The background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mr/hr.

6.0 FIGURES

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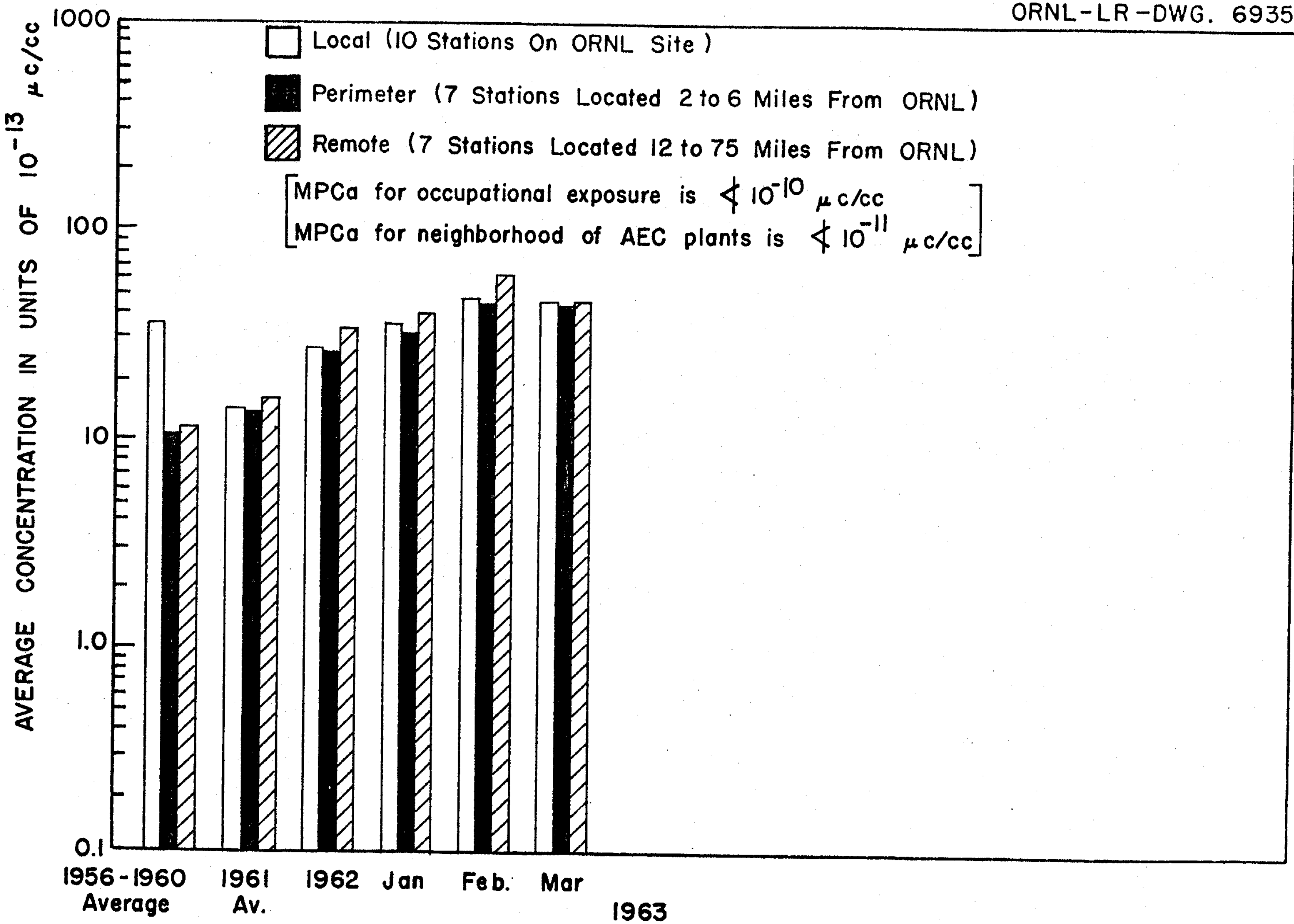

Fig. 6.1 Concentration Of Radioactive Materials in Air (Filter Paper Data)

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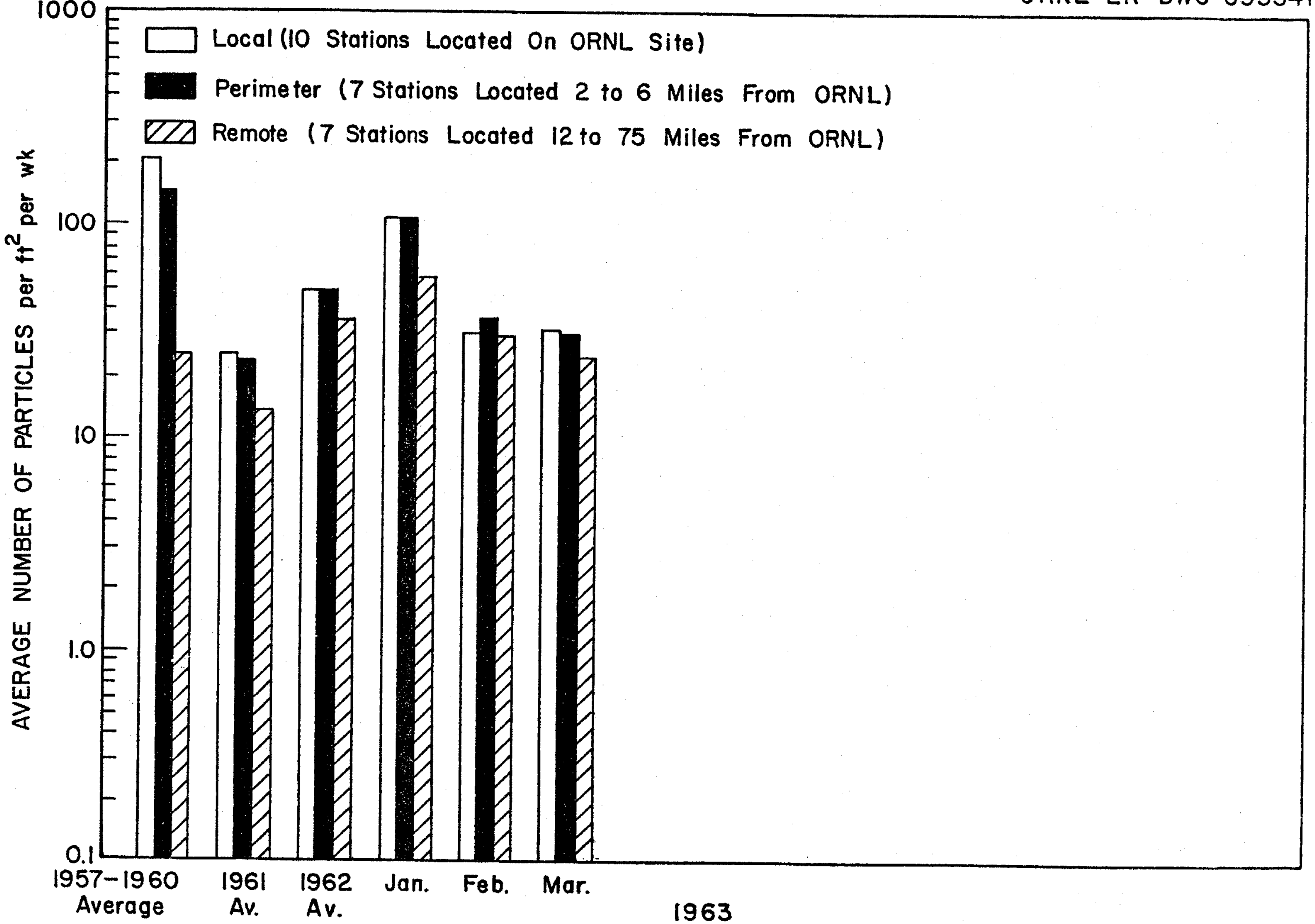

Fig. 6.2 Radioparticulate Fall-Out Measurements (Measured By Autoradiographic Techniques Using Gummed Paper Collectors)

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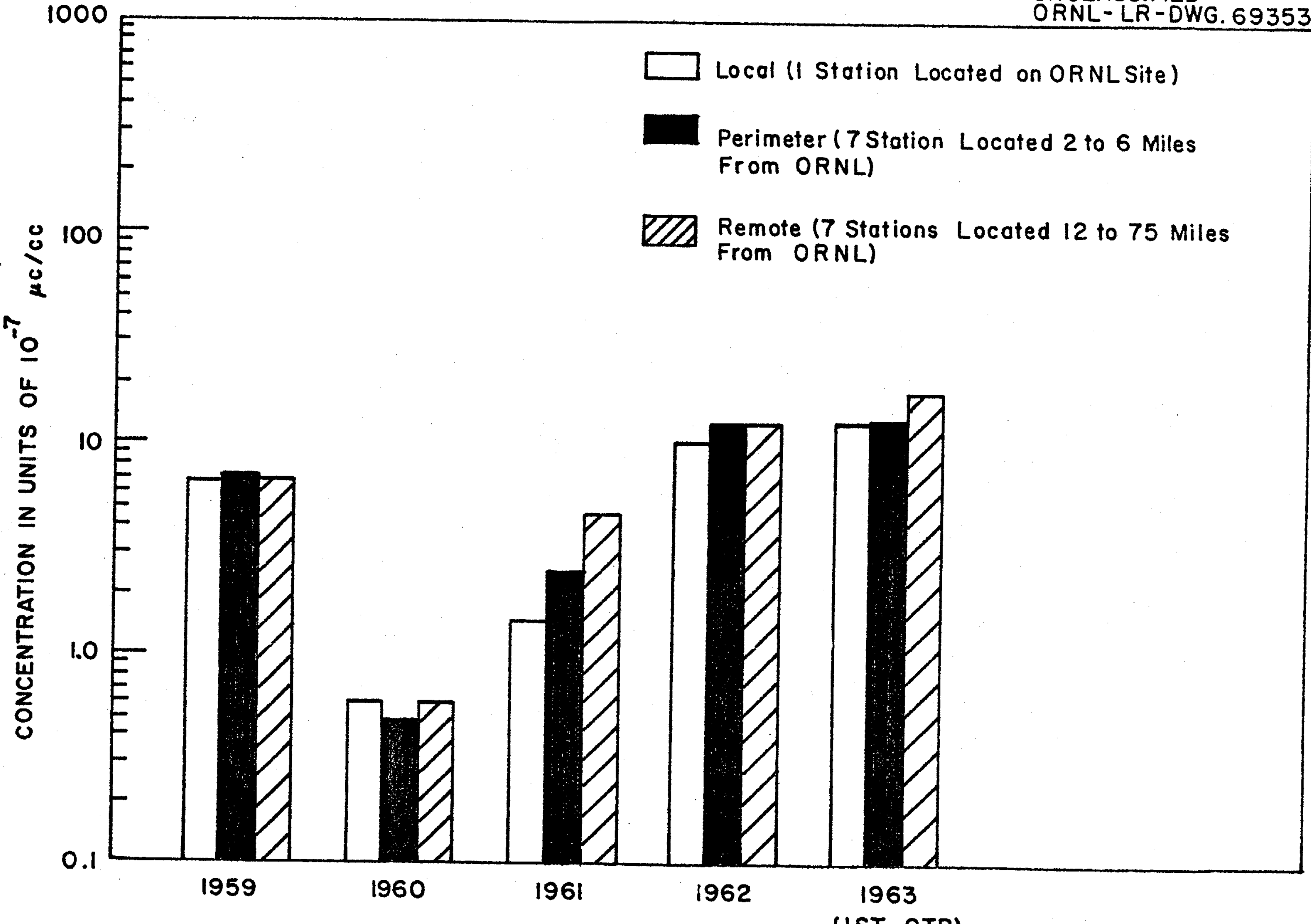

Fig 6.3 Concentration Of Radioactive Materials In Rain Water

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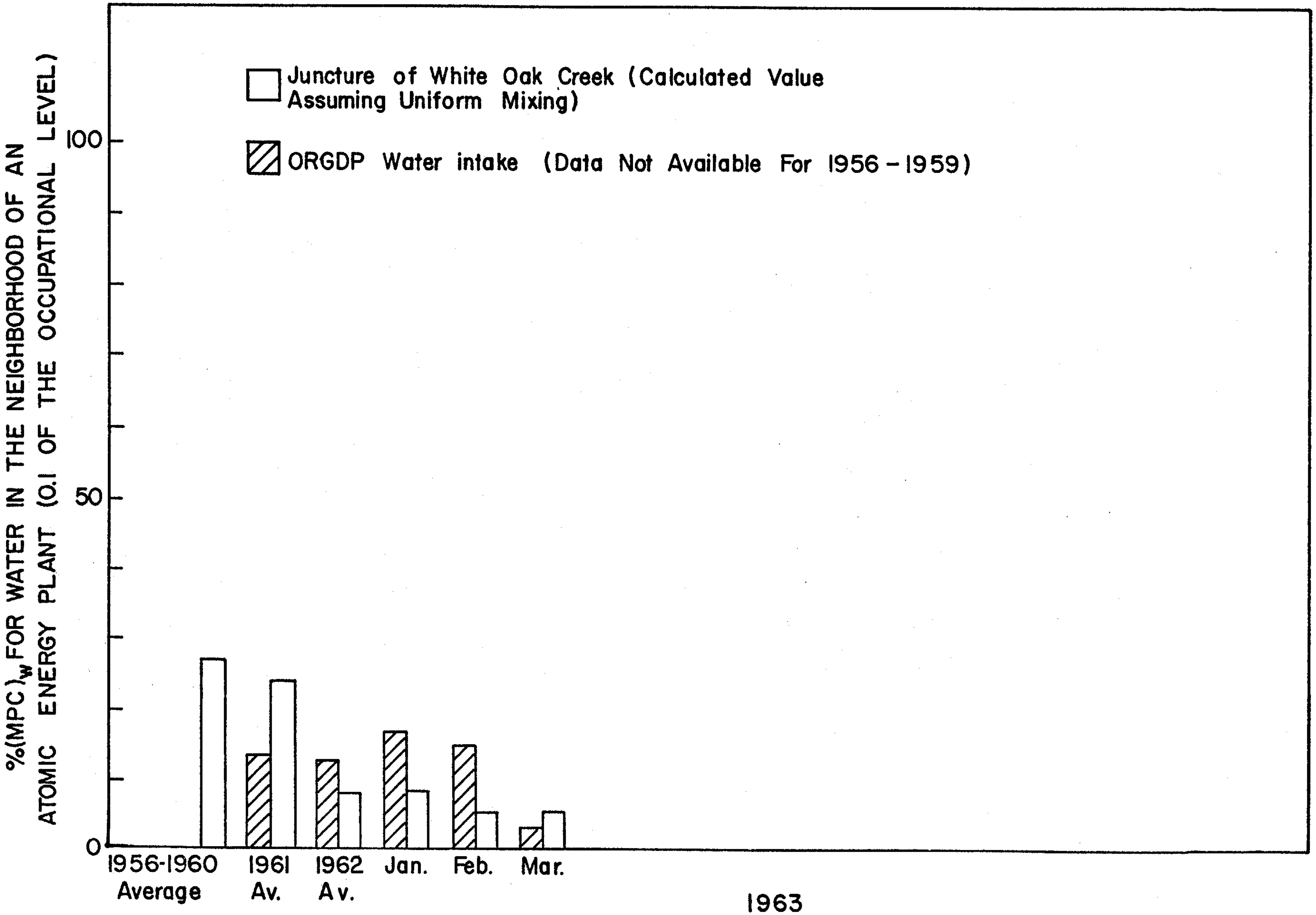

Fig.6.4 Radioactive Content Of Clinch River Water

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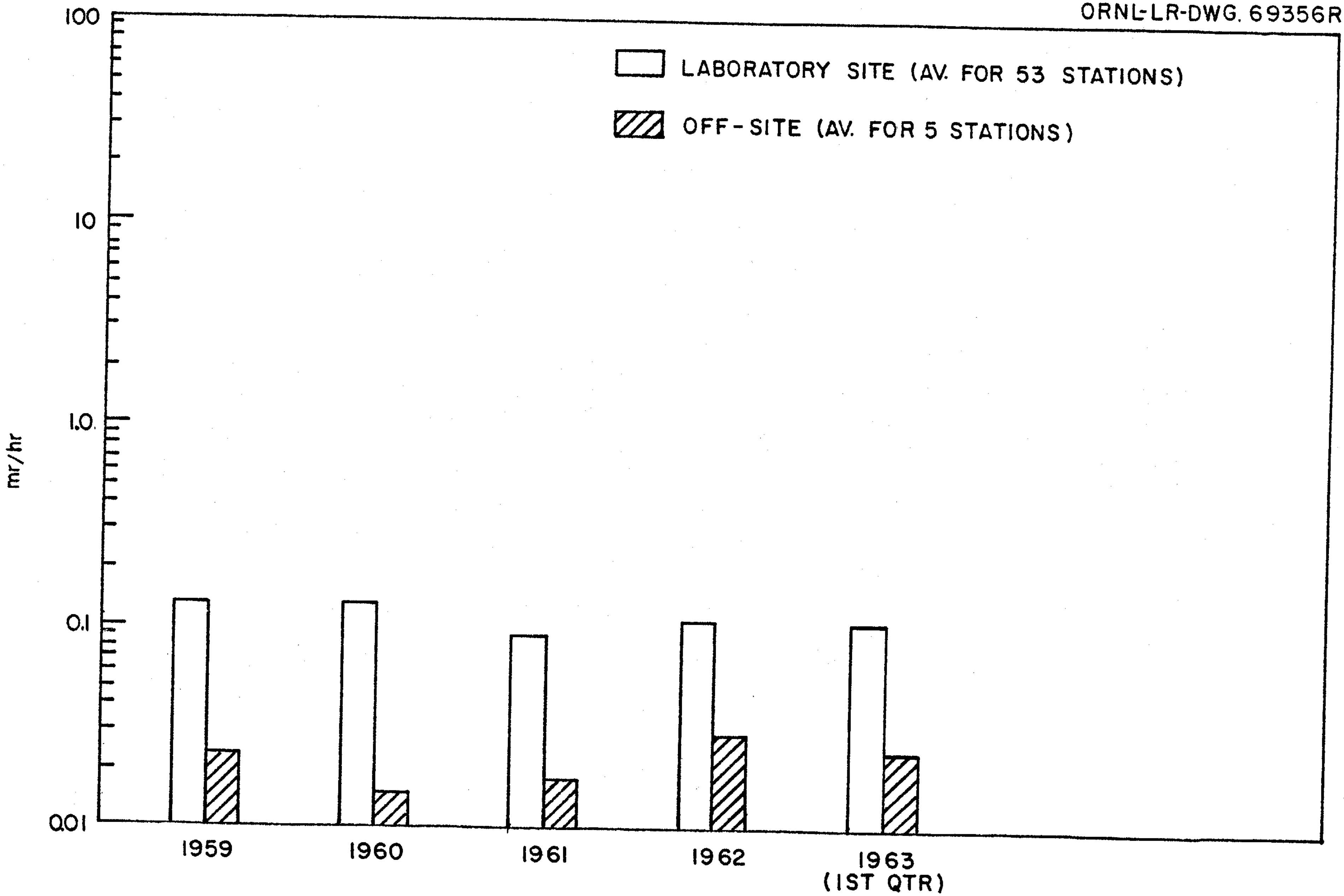

Fig 6.5 Background Measurements Of Ionizing Radiation

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